Ultimate Guide:
Compression

by Cymatics

A complete guide to understanding audio compression

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Compression

Introduction

Compressors and limiters are amongst some of the most used tools by music producers on a daily basis. Due to this fact, you could say that learning how to use them is a simple task, and to be honest, it’s truly not that complicated.

We just believe that compression is a heavily misunderstood topic; That’s a better assessment of the subject rather than saying that compression is a really complex topic.

So let’s get started!

One of the best ways to think about compression is as volume automation.

You may argue against this by saying that professional producers have found more complex uses for compression based on how it alters our perception of the audio signal.

Some of these other uses may be gluing drums together, adding harmonic excitement, fattening sounds, and even accentuating or adding groove.

All of this stands true and those are terms that you might have heard at least once if you have been producing for a while. However, it gets really challenging trying to understand how that happens when you haven’t even grasped the fundamental concept to begin with.

Try loading a raw drum loop from any sample pack that was recorded live. A raw vocal recording might work as well, but drum loops usually work better to illustrate this concept.

If you listen critically, you will notice that some drum hits are louder and some are quieter (Assuming the drum loop didn’t get processed previously, so it’s worth putting some emphasis on the word raw).

You could do volume automation with the channel fader or a utility plugin to bring down the really loud parts and bring up any other elements that may be too quiet.

That is actually a viable solution that allows for surgical precision, but it’s ridiculously time consuming (as if creating a track from scratch wasn’t hard enough already).

But what if we told you that you could achieve this with a compressor and that this is one of its fundamental uses?

It’s fair to say that a compressor is just a really smart algorithm that deals with volume, and it yields similar results as doing time consuming volume automations everywhere where you might need it.

But how does this algorithm know how to operate? Well, you need speak to it in terms of volume, as its the only thing it understands. It’s really, really smart, just in that one area.

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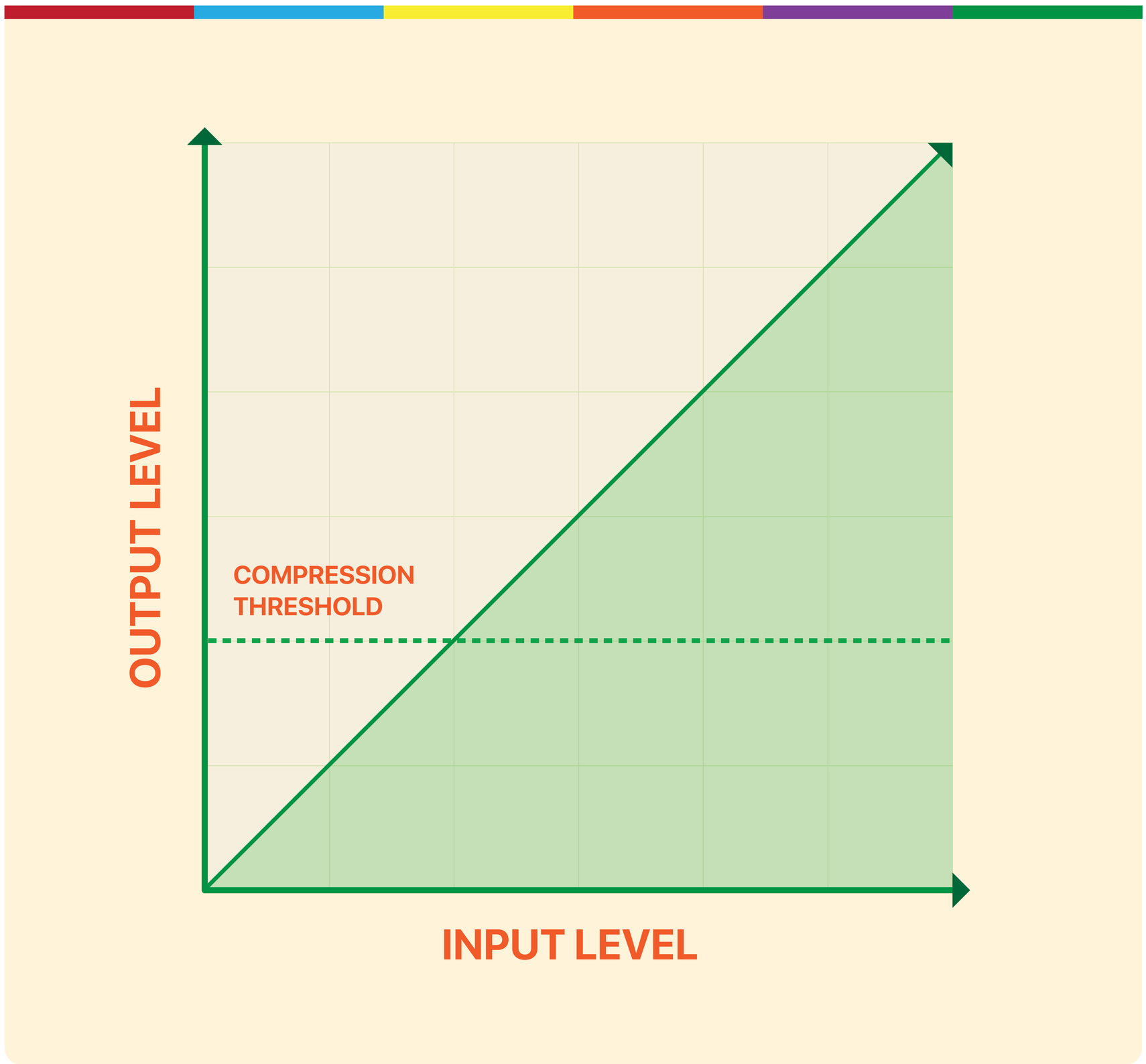
Threshold

“When should the compressor start working?”

You should know by now that any audio signal can go from -∞ to 0 dBFS without clipping in the digital domain, so this is the first fundamental question that you need to answer.

If you set your threshold at -20 dB for example. Your compressor will work on any signal that exceeds that value.

We would like to put a lot of emphasis on making clear that the threshold doesn’t have any effect on the signal itself, it merely tells the compressor where it’s allowed to work.



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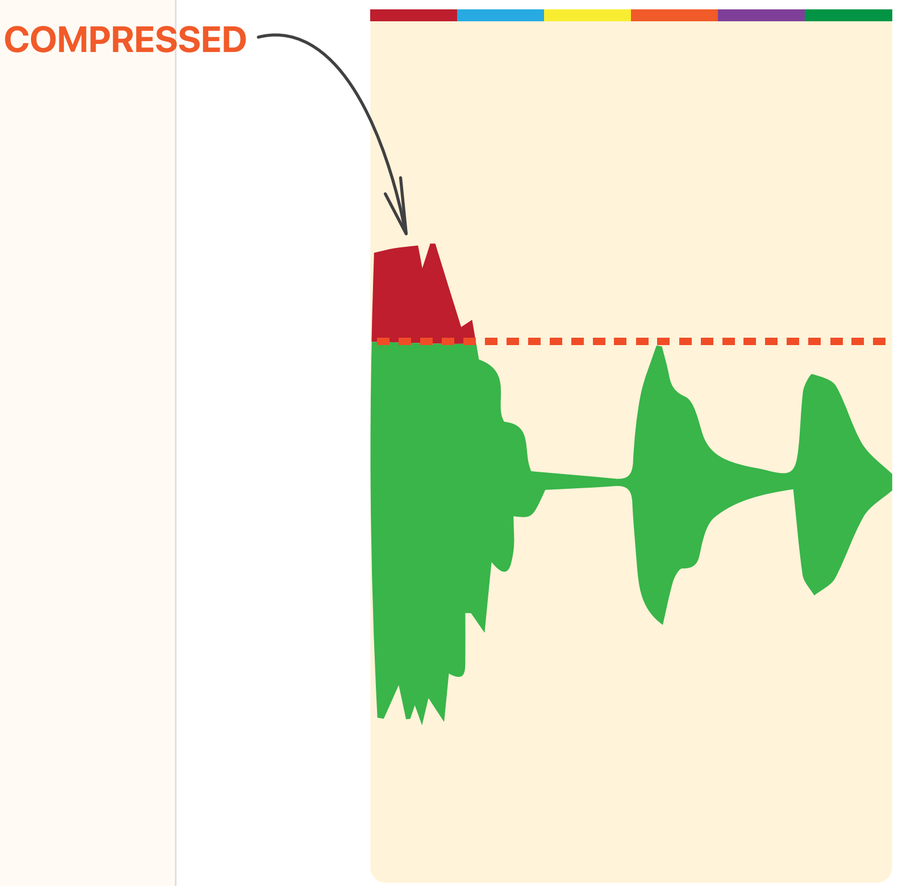
Ratio



“How much should the exceeding signal be brought down?”

Anything below the threshold doesn’t matter, for the compressor only anything that goes above the threshold is fair game.

The solution engineers found to this problem was to use ratios expressed in the form of **input:output**, as this would solve the issue of having very dynamic input signals—such as drums—where it doesn’t really make a lot of sense to have hard set gain reduction values.

To exemplify this, a 2:1 ratio simply means that any input signal that exceeds the threshold by 2 dB will only output 1 dB.

So having a ratio would bring different drum hits down proportionally depending on how much they exceed the threshold by, instead of just decreasing every single hit by a hard set value, for example, of 2 dB.

If the kick drum in your drum loop exceeds the threshold by 10 dB and your snare exceeds it by 6 dB with a 2:1 ratio, the output would be different and proportionate for both of them.

The compressor would only output 5 dB of the exceeding 10 dB for your kick drum, and it would only output 3 dB out of 6 for your snare drum.

So, a 10:1 ratio simply means that any input signal that exceeds the threshold by 10 dB will only output 1 dB above the threshold (9db total of gain reduction).

As you may be infering by now, both the threshold and ratio play major roles on how hard the compression is.

As a decent rule of thumb, you can think about compression ratios in the following way:

3:1 and values below - **mild/soft compression**

5:1 - **moderate compression**

8:1 - **strong compression**

20:1 to ∞:1 - **limiting**

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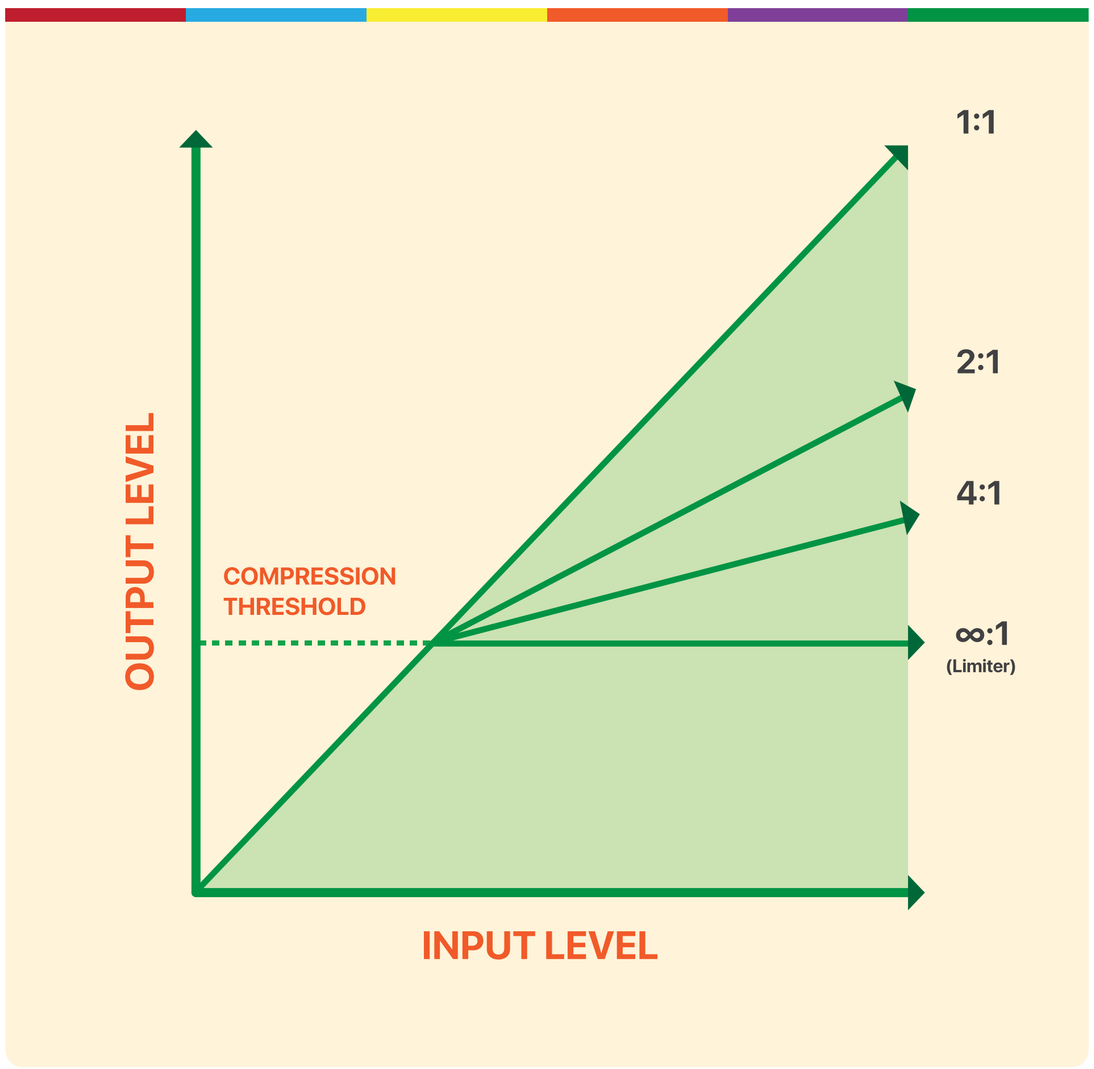
Ratio (Continued)



Note: *A ratio of 1:1 would have absolutely no effect on the input signal.*

Now it's a good time to talk about **limiting.** You may have noticed that even with moderate compression ratios, there's still a small amount of signal that goes through.

Limiting simply means that nothing is going above the threshold and the audio signal is getting smashed against the compressor/limiter. This isn't necessarily a bad thing, and sometimes it's necessary, but you definitely want to be cautious with this.

It's also worth mentioning that using compressor presets takes a little bit more of effort compared to using synthesizer presets. But why?

Compressors are gain dependant plugins.

The engineer or producer that designed the preset doesn't really know how loud the signal you will be using it with is. It's even possible that your signal isn't loud enough and it's not going past the threshold, therefore not even having an effect.

It's always a good idea to bring the threshold up to 0 dB and adjust it accordingly to your material so you can proceed to analyze and come to a conclusion on why the other parameters were set up that way.

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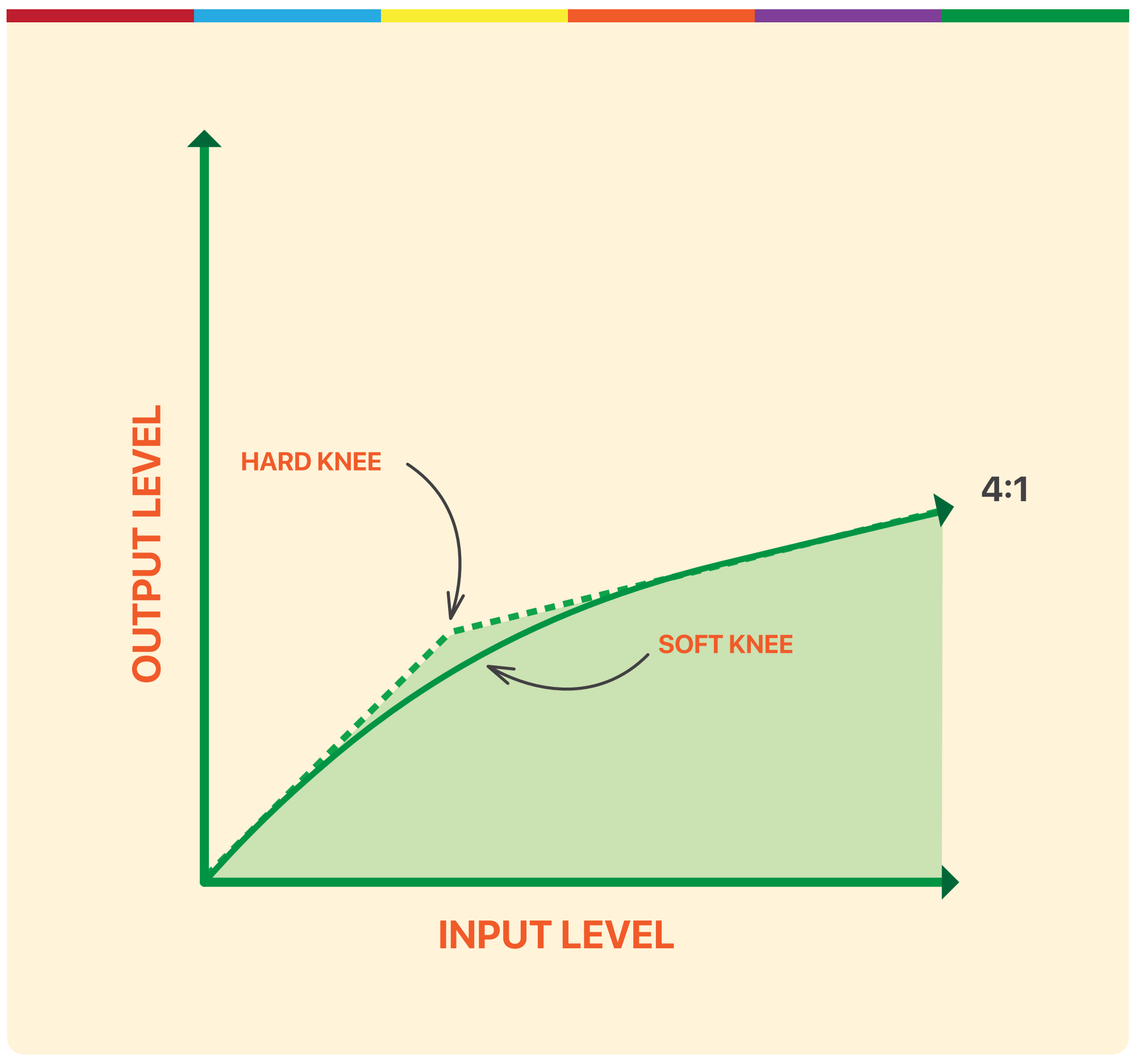
Knee



Most compressors have a knee setting, and it's also another control that helps dictate how hard the compression is.

The knee setting simply sets up how abrupt or how gradual the compression is.

What does this mean?

A hard knee or a value of 0 makes the compression binary. It either happens, or it doesn't. Anything below the threshold isn't affected at all, only parts of the signal that exceed the threshold.

However, when you start increasing the knee value, or have medium or soft knee settings, the compression gets eased in. It's just like a color gradient.

If you have an 8:1 ratio for example, mild compression starts to happen in the signal when it's below the threshold, with a 2:1 ratio for example.

Once it gets closer and closer to the threshold, the ratio increases until it goes well above and it's fully applied. It's pretty hard to tell how the compression gets eased in with exact values, as every compressor is designed differently and it depends entirely on the manufacturer.

Pro tip: *It's really good practice to stick to a few compressors in the beginning and really learn how they sound and affect multiple signals with various settings.*

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Makeup Gain

To have a solid understanding of make up gain, there's one prerequisite. This prerequisite is understanding the definition of dynamic range.

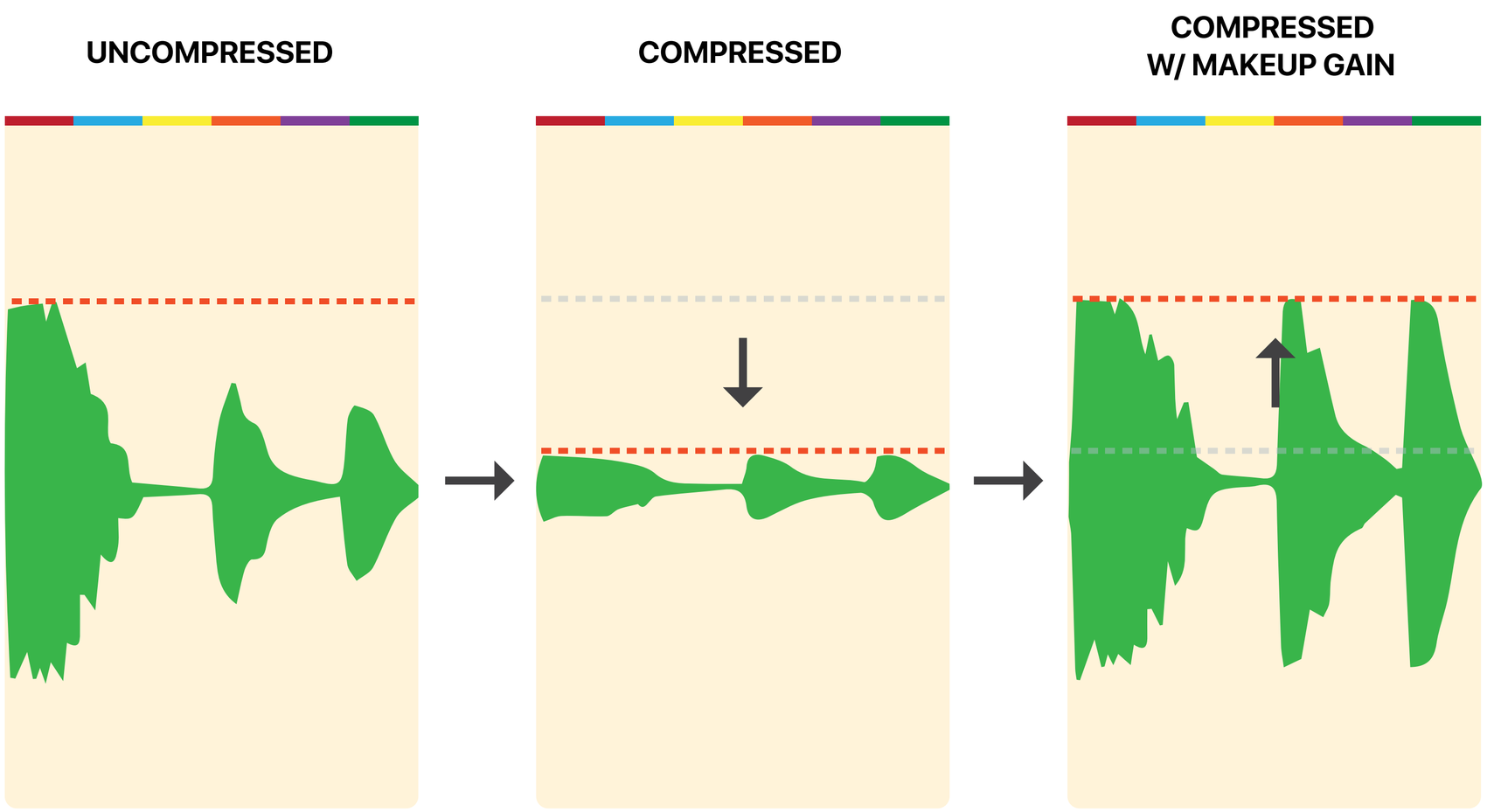
In a nutshell, dynamic range is is the difference between the loudest part of your song, and the quietest part.

Imagine using a beard trimmer with the biggest guide comb available. If your beard is messy, it will clip those long, messy, and unwanted hairs, but it will leave the rest unaffected.

That is the equivalent of reducing the dynamic range in a song.

Now, imagine you grab a smaller guide comb for your beard trimmer and proceed to cut some more. Your beard should start getting about the same size pretty much everywhere, and this will stand true if you keep using smaller and smaller guide combs every time.

This is basically what compression does to your audio with the help of make up gain, and it's a two step process unless you do not use make up gain.



First, it will bring down—or cut in our analogy— whatever is going above the threshold, and the make up gain will bring up in volume everything at the same time.

This is the reason why compression makes things perceivably louder.

Makeup Gain (Continued)

The difference between the highest and lowest peak gets decreased and everything gets brought up to the original volume level at the same time. Of course you can always add extra make up gain that exceeds the original volume level, but this isn't always the case nor necessary.

Many compressors have an automatic make up gain function. However, many professionals are against it and prefer to setup this parameter manually as it becomes a little bit harder to assess whether you're benefiting your input signal or not.

This shouldn't discourage you and make you avoid the automatic make up gain function though. Some compressors like FabFilter's Pro C-2 actually have pretty good automatic make up gain algorithms.

Attack & Release

The attack and release settings are pretty straightforward.

The attack simply dictates how long does it take for the compressor to engage and bring down the signal once it has gone past the threshold.

The release setting simply tells the compressor how long should it wait to disengage after the signal has gone below the threshold once again.

As we will explain briefly in a later section, some compressors are either faster or slower in nature compared to others even though they may still have attack and release settings. This is simply because of how they were designed, built, and programmed.

Fast attack and release settings and any of its permutations are useful in different scenarios. There's no rule on how to set up these parameters, you just need to know what you're trying to achieve.

Really fast and dynamic signals will usually go past the threshold and go below it once again in quick successions, so it's usually a good idea to let the compressor recover with a fast release before the next transient happens.

On the other hand, fast attack settings can help tame really sharp transients and clicky sounds that otherwise may be eating up your headroom or simply sound bad.

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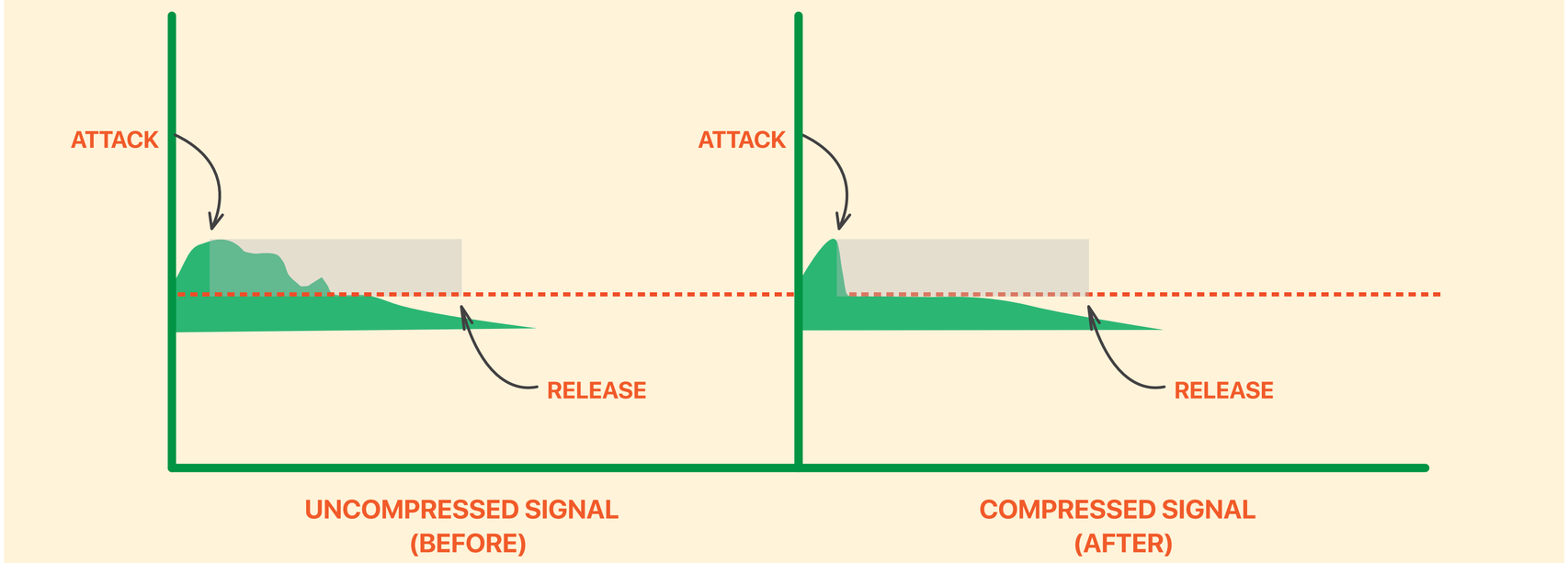
Attack & Release (Continued)



A slower attack will allow fast material to come through clearly, such as the aforementioned transients, before the compressor engages and brings everything down.

This is usually something desirable with input signals such as kick drums. You don't want to smash completely the transient so it has a nice and clean attack, but compressing the tail can yield amazing results.

Most modern compressors have an automatic release time setting, and people tend to agree that this setting is usually a little bit smarter compared to most automatic make up gain settings.

This is usually a pretty nice starting point, as the compressor analyzes how frequently the signal is going above the threshold, if there are low frequencies present, and some other variables. From there, you can tweak and come up with a manual release time that brings you closer to your desired result.

Pro Tip: *Starting with a slow attack and a very fast release should help you come up with optimal settings for most audio signals.*

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Sidechain Compression

Sidechain compression is arguably one of the most famous techniques in electronic music production, and even in music production in general across multiple genres.

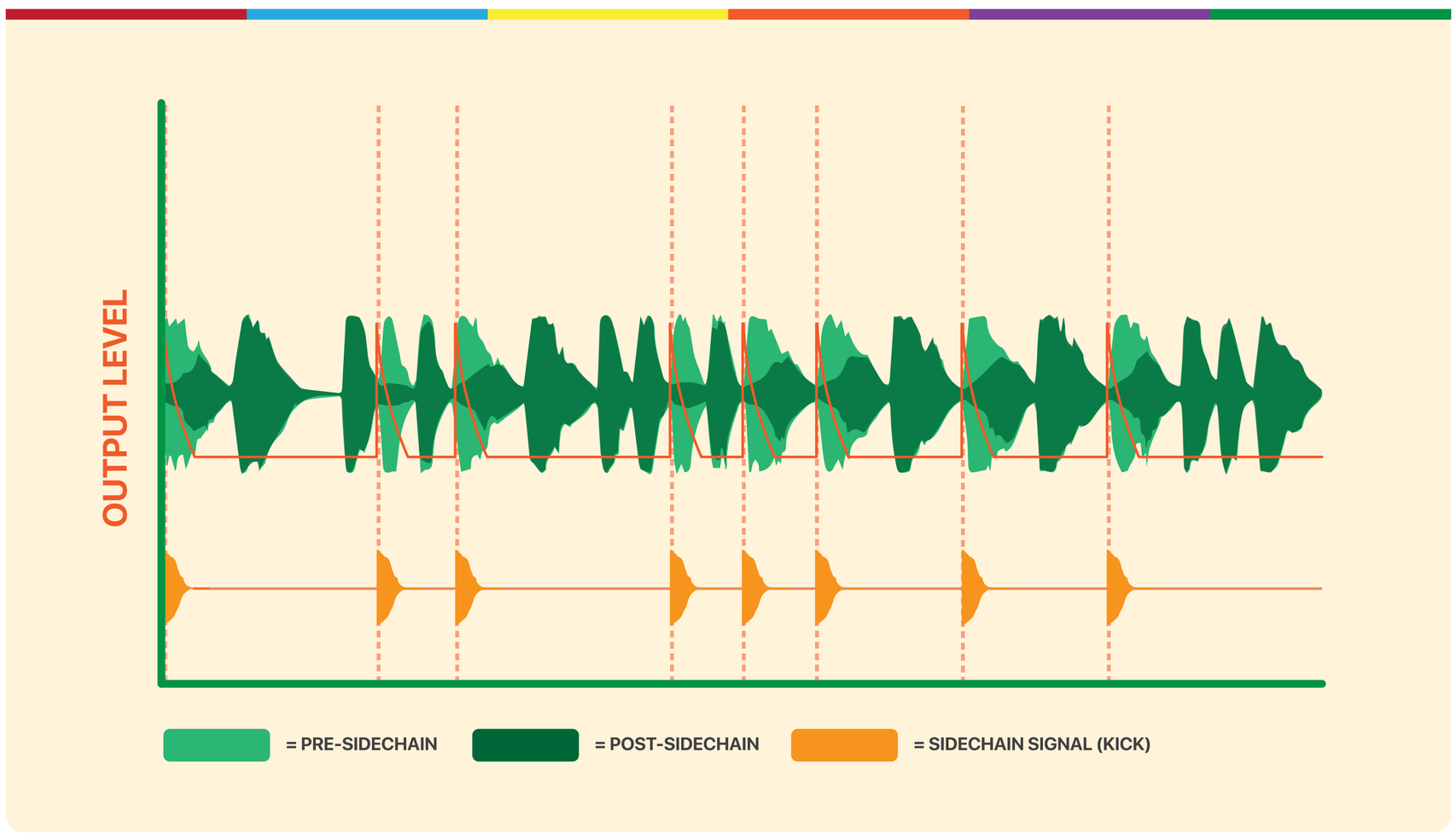
What this allows the compressor to do is to analyze any audio signal other than the one that lives in the compressors channel and apply gain reduction based on it.

You may be aware that low frequencies are somewhat delicate and that things can get muddy down there really quick. Without going into many specifics, it's fair to say that you can't have your kick drum and your bassline happening at the same time.

So, if you put a compressor on your bassline and sidechain compress it to your kick, this would allow the compressor to analyze the incoming kick drum signal and duck the bassline out of the way really quickly so your kick can punch through.

You can't have an elephant and a hippo in the same room, at the same time. It's one or the other.

There are multiple uses for sidechain compression, and even creative ones, but this is the most common use for sidechain compression (and the best way to learn it in our opinion).



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Types of Compressors

Now that you know about the underlying principles of compression, we can briefly mention some of the most common types of compressors out there. Every single producer tends to have its own preferences on how they use these compressors, or whether they use them at all.

This is primarily focused on shedding some light on how deep the compression rabbit hole can go, as each type of compressor has unique intricacies that we could spend pages and pages discussing and talking about.

This is without even mentioning that you will be able to find a plethora of compressors with unique characteristics that are specific or unique to certain different manufacturers.

So let's get started!

Tube Compressors

Tube compressors are the oldest ones out there, as tubes were pretty much the only solution available back then as transistors and smaller electronic components didn't even exist.

They tend to have a unique sound once the tubes get hot, and for this reason producers tend to use them as flavor/ colouring tool rather as a way of dynamic control (even though it's possible).

Tube compressors are pretty slow in general, both in their attack and release phases.

Optical Compressors

Without getting too technical, optical compressors alter the dynamics of audio signals via a light bulb or a LED in conjunction with an optical cell.

Basically, higher amplitudes emit more light making the compressor attenuate the output respectively.

One could assume that optical compressors would be fast because of the speed of light, but they actually have a small delay because of this reason.

Their attack phase is generally sluggish, with a "quick two stage release". They let go quickly, but once there's not a lot of light they become slow to return to their full disengaged state.

FET Compressors

"Field effect transistors" or FET compressors are basically the evolution of tube and opto compressors. They try to emulate their sound with modern electronic components, transistors.

Since these compressors are their "modern counterpart", they are widely known for their ultra fast attack and release capabilities. Making them a great choice to get over compressed, smashed, yet musical sounds.

VCA Compressors

"Voltage Controlled Amplifiers" use even more modern circuitry to achieve gain reduction, as they use solid state or integrated circuits for this task.

They are way cheaper than tube or opto compressors, and they're also pretty much colourless (transparent in other words).

They tend to have both really quick or slow attack and release capabilities.

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Peak vs. RMS

Peak vs RMS is a slightly tricky or slippery subject to understand, so we'll try to break it down as simple as possible.

The peak value is the loudest instantaneous moment in an audio signal.. That is a keyword to remember, instantaneous. Load a drum loop into your DAW and check your channel meters, as those are reading peak values.

Your channel meter will mark the loudest point in any given moment during the entirety of that drum loop.

On the other hand, RMS measures average levels. It is a slow measurement that averages out peaks and troughs of short duration to reflect the perceived loudness of your signal.

So following this line of thought, you may deduct that sustained sounds will have a much higher RMS reading than percussive ones. This is because percussive sounds are just a brief spike of energy.

Now that you have a better understanding of these concepts, we can explain that there are compressors that have detection mechanisms that react either to peak values or RMS values.

Peak compression is usually way better to catch really fast bursts of unwanted energy or transients that may be living in your mix.

On the other hand, RMS compression is way more useful to increase the perceived loudness of a signal, as your compressors won't be jumping up and down reacting to those peaks.

Final Thoughts

Now that you have a solid understanding of how these dynamic processors work, you can dive deep into some of the concepts that we initially mentioned on this book. Such as fattening sounds, enhancing grooves, gluing drums together, and even adding harmonic excitement.

As you can see, it’s hard to explain those concepts or even try to set steps specific steps to accomplish them, as it is fairly subjective and highly dependant of your input signal.

You now have a solid foundation and logical understanding of how to use compression to achieve different results, compared to just doing it arbitrarily because some other producer advised you to.

You now also have general knowledge about the different type of compressors so you can dig deep and explore them as coloration tools rather than just a form of dynamic control.

After all of these, we hope that you understand why we believe that compression is a highly misunderstood subject that has unbelievable creative potential, rather than a complex one.

We hope that you take this one step further and do research on your own and develop your own compression techniques!

Best of luck and happy producing!

Best Plugins:
Compressors

FabFilter Pro C-2 ($179)

Popular for: Any type of compression.

Overview:
One of the most clean, versatile, and easiest to use compressors in the market. FabFilter really outdid themselves while designing this plugin, as it arguably has the best UI out of all. If you're on a budget and need a third party compressor that will serve multiple purposes, this should be your go to. It's like having 8 different compressors in one.

Pros

- Incredibly versatile, 8 different compressor modes.
- Amazing user interface.
- Custom knee setting, smart auto gain algorithm, hold function, and smooth lookahead.

Cons

- Setting up the sidechain is a little bit time consuming.
- It doesn't replace old analog compressors that give colouring or character to your instruments.

FabFilter Pro-MB ($199)

Best Used For: Anything from overall clean compression to surgical cleaning tasks.

Overview:
FabFilter turned multi-band compression into a really simple task with this plugin. And as it is to be expected from them, the UI is spotless and incredibly easy to use. This multi-band compressor is loaded with multiple features that you didn't even know you needed, a benchmark in the market.

Pros

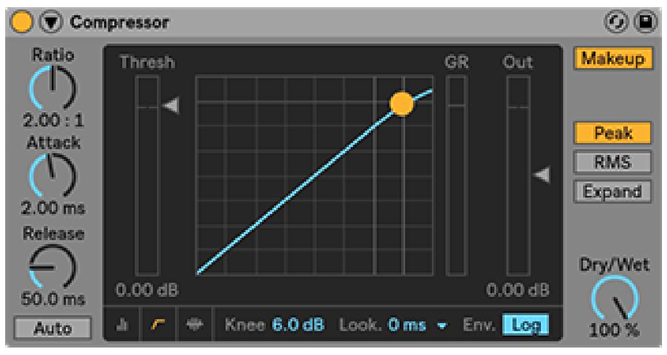
- Unique and ultra clean dynamic phase mode
- Linear phase mode eliminates all audible artifacts
- UI is so well designed that it makes multi-band compression simpler, also works well as a single band plugin.

Cons

- Bands have a limit on how narrow they can be.

Best Plugins:
Compressors

Ableton Live Compressor (Free*)



Popular for: Simple dynamic control tasks and sidechain compression.

Overview:
Ableton's stock compressor does a pretty good job even though it may not be popular amongst many producers, as it also lacks a flashy or eye catching UI. For both beginner and expert producers, this compressor is an incredibly handy dynamic control tool that you shouldn't disregard. (*Included free with Ableton Live)

Pros

- Free, included in all versions of Ableton Live.
- Simple and quick to use.
- Has an RMS and Expansion mode, which not a lot of other compressors have.

Cons

- If you're looking for coloration, this compressor isn't really suited for that task (this isn't necessarily a con).
- Sidechain compression can sound clicky sometimes.
- Automatic make up gain algorithm isn't the best (compared with FabFilter for example).

Native Instruments Supercharger GT ($99)

Best Used For: Enhancing, driving/saturating, and shaping your sounds.

Overview:
The Supercharger GT is Native Instrument's take on modern tube compression. More than a form of dynamic control, this compressor excels at sculpting and adding character to sounds. And it just doesn't end there, as this compressor also has a saturator with 3 different modes available that take things to the next level.

Pros

- Thanks to its multiple settings, it creates a pretty wide spectrum of tone shaping possibilities.
- Pretty intuitive UI
- Mid/Side compression setting available

Cons

- Tube compressors are a little bit slow by default, so this isn't fitted to control really dynamic signals (this isn't necessarily a con).

Best Plugins:
Compressors

NI Vintage Compressors ($199)

Popular for: Anything from dynamic control to coloration.

Overview:
If you're looking to get started at exploring compression beyond the usual dynamic control, this bundle is an incredible choice as it includes a FET compressor, an optical compressor, and a VCA compressor. You're getting the best out of all worlds with these incredible analog emulations developed by Native Instruments.

Pros

- Decent emulations with added improvements on the original hardware units.
- 3 different compressor types in one bundle

Cons

- Some people argue that emulations done by other manufacturers are more accurate. However, they're also more expensive.
- UI's could definitely be better.

iZotope's Neutron 2 Compressors ($129-499)

Best Used For: Any mixing task that needs to be done, as the advanced edition is basically an entire mixing suite.

Overview:
The Neutron 2 mixing suite is arguably iZotope's most popular plugin. It includes six different processors, including two compressors. These compressors are extremely versatile, as they can be incredibly transparent, but they also have available a vintage mode for colouring purposes. If you use Neutron 2 in conjunction with Ozone 8, all your mixing and mastering needs should be covered.

Pros

- You get more than compressors with any edition.
- Offers both transparent and colouring compressors.

Cons

- If you're only looking exclusively for compressors, dedicated single plugins might be a better choice as they're not for sale individually. You need to buy at least one of the three editions.

Best Plugins:
Compressors

Waves CLA Classic Compressors ($599)

Popular for: Used in multiple hit records for years, they're widely known for their unique character both subtle and extreme.

Overview:
The Chris Lord-Alge classic compressors are Waves take on the legendary 2A, 3A, and the 1176. These analog hardware units have stood the test of time for a reason, as they're incredible coloring and dynamic control tools. Unlike the Native Instruments bundle, you could say that the Waves bundle includes an "extra" fourth classic compressor, as the 1176 comes both in the "black" and "bluey" edition. However, the differences between these editions aren't big.

Pros

- Great classic emulations
- Three different compressors in one bundle

Cons

- Extremely expensive even for professional producers. Waiting for a sale is a good option.

Cytomic The Glue ($99)

Best Used For: Any mixing task that needs to be done, as the advanced edition is basically an entire mixing suite.

Overview:
This compressor is one of the best emulations of the legendary SSL bus compressor, with a slight modern approach. Ever heard of the term gluing elements together? Well, the SSL bus compressor is the one that basically originated this term. A must-have plugin in your toolbox to finalize any kind of mix, regardless of the genre.

Pros

- One of the best glue compressors/SSL emulations in the market
- Better UI compared to other competitor's emulations
- A free version made by Cytomic comes with some versions of Ableton Live (Glue Compressor)

Cons

- No automatic make up gain. Some of the emulations developed by competitors have this function.

Best Plugins:
Compressors

Image Line Maximus (Free*)

Popular for: Maximizing audio levels

Overview:
Maximus is Image Line's stock compressor/limiter/maximizer plugin for FL Studio. It has 3 bands available plus a master band, which applies even extra compression to the final output. This plugin is extremely powerful and it shouldn't be overlooked just because it wasn't developed by a third party company. (*Included free with FL Studio)

Pros

- The fact that this plugin is incredibly powerful and functional, yet free, makes it one of its biggest features.
- Great tool for the "loudness wars"

Cons

- The workflow and UI may look a little bit outdated compared to other maximizers in the market.

Xfer OTT (Free)

Best Used For: Heavy OTT-type compression, sound design

Overview:
OTT was developed by Xfer Records and it's basically a multiband compressor that does specifically over-the-top compression. OTT is a famous type of compression used by many dubstep and electro producers and it has a very characteristic sound.

Pros

- If you're going for straight OTT compression, this plugin is designed specifically for it. It's quicker than using any other multi-band compressor.
- Incredibly intuitive in comparison to other multiband compressors that have OTT capabilities.

Cons

- Can be a little bit harsh on the high end
  It's a very focused tool (OTT compression), so it has fairly limited tweaking options.